Jennifer Stock: Today, we will be talking trash on a global level. It's not really a pretty picture today, but hopefully there's hope to think about for changing the future. Towards the end of the program, we'll be talking with a local artist, Richard Lang, about a local art installation that features the global issue of plastics in the ocean, but first I'll be talking with Captain Charles Moore, the founder of the Algalita Marine Research Foundation, a non-profit environmental organization dedicated to the preservation of the marine environment. I had the pleasure of sailing with Charlie last year to assist and learn about Laysan albatross breeding on Guadalupe Island, Mexico.

Charlie is passionate about the ocean and has spent most of his life sailing on the high seas. It was through his trans-oceanic voyages that he discovered an enormous area in the north Pacific that surrounded his boat with plastic. Charlie has since worked to to quantify what he saw. Through his studies, he found that an area in the size of the ocean about the size of Africa had en masse, six times more plastic particles than plankton in the water column. Ever since, Captain Moore has dedicated his time and resources to understanding and remediating the ocean's plastic load. He works feverishly on the national and international level on issues facing the oceans and coasts and long-term health effects on humans and the marine environment.

Welcome, Charlie. You're live on Ocean Currents.

Charles Moore: Oh, thanks Jennifer. It's great to be on your show.

Jennifer Stock: Excellent. So, Charlie, I first want to ask, how did you find yourself in the middle of the ocean surrounded by trash? What were you doing out there?

Charles Moore: Well, we had entered the Transpac Yacht Race to test a new mast. This mast, after having built our research vessel in Hobart, Tasmania and sailed it to Fiji and American Samoa, we were on our way towards the equator when a squall broke our mast off and so we had to retreat and couldn't get a mast in Samoa. So, we had to put the boat on top of a freighter carrying Star-Kist tuna from American Samoa to San Diego and get a new mast built here in the LA, Long Beach area and we wanted to test it out under extreme conditions, make sure we never have this problem again.

So, we entered a race. We were actually the first catamaran to ever officially enter the Trans-Pacific Yacht Race from San Pedro

Island to Honolulu because being a research vessel, we're slower than the other catamarans. That was...'97 was the first years they allowed catamarans to officially enter the race and we had a handicap because of our weight. So, we were the first catamaran to ever officially start the Transpac and we did well. We got first in our division and third in our class and we hit a top speed of 20 knots under sail and the mast held up good and when we got to Hawaii, you know, it's a straight line, basically, between LA and Hawaii when you do the Transpac and you try to avoid this area called the North Pacific Gyre because it lacks the winds you need to sail a fast race and on the way back, most of the sailors avoid it by heading north towards Alaska and then hanging a right around the Washington border and then sailing, catching the westerlies up there and then sailing back and coming down to the latitude of LA, but we're a research vessel and we had twin diesel engines and we had a supply of fuel and so we decided to take a shortcut through this gyre.

'97 was an El Nino year. So, the high was really big and really in place and it was quite calm out there and the calmness does allow whatever debris is out there to float to the surface if it's lighter than water. So, I was just shocked to see in the whole week it took us to cross this huge atmospheric system, everyday, I mean, I couldn't go on deck without seeing some kind of debris floating by. You know, that's about as far away from land as you can get anywhere on Earth. It's about a thousand miles from Hawaii and 1,000 miles from San Francisco and, you know, there shouldn't be any trash out there. I mean, nothing really makes it out there. There's no seaweed out there. There's no insects, really. There's no man-made debris except for plastic and I was shocked because I sailed that Hawaii route when I was 14 years old back in the 60's and never remembered seeing debris, but every day when I went on deck and any time of the day or any time of the night, if I just stood by the rail and looked over, I would see something floating by and I said, "Well, you know, if this stuff weighs...if I'm in the middle of a system, and this stuff weighs, say, a half a pound per 100 square meters, I've got the equivalent of the largest landfill in LA out here floating around," and I got curious and just started to talk to some scientists and see how we could come back and quantify the amount of plastic in an area that, you know, is so enormous and so surprisingly polluted, so far from land.

So, we got a sample design from the Southern California Coastal Water Research Project and their statistician helped us design a plan to go back and sample that area and a couple years later we were back out there with what's called a manta-trawl , it's like a

manta ray with a big, wide mouth and wings on it and it skims the ocean surface just like a manta ray does catching zooplankton, anything bigger than a third of a millimeter and we skimmed that thing for over 100 kilometers, random distances both day and night and brought the samples back with us and quantified them and we were shocked to learn that for every pound of plankton we got, we had picked up six pounds of plastic fragments. So, that shocked the scientific world and shocked us and ever since then we've been trying to figure out how we can stem the tide of plastic running into the ocean.

Jennifer Stock: Charlie, did you, when you're out there both sampling and for the first time, could you tell where some of this stuff came from because some of the time this debris has, you know, lots of writing and inscriptions on it? You can somewhat tell where it's from. Did you have a good sense of where a lot of this has come from?

Charles Moore: We can sometimes tell where, what we call the macro debris comes from, the larger bits are maybe objects we can identify or have markings on them, but the micro debris, stuff less than 5 millimeters in diameter, it's completely where that comes from. So, in the macro debris, it's sort of a fluke that most of it comes from Japan and the coast of Asia and the reason is that it only takes about a year to get out there, maybe even as little as six months if it's got a lot of windage because the winds are blowing from west to east and pushing the stuff towards the United States.

I mean, we know about the upper air currents doing the same thing. You fly to Hawaii, it's going to be a lot faster coming home than it is going from California to Hawaii. You save about an hour and that's the upper air currents of the jet stream flowing from Asia to the United States and we know that the particulates from Asian air pollution reach San Francisco. I believe there's a sampling station on Mt. Tamelpais for that.

So, those winds, those currents push debris too at the sea surface level and Asian debris makes it to this garbage patch where it kind of re-circulates in a very quick time. So, what happens is the sun will break the larger bits of debris into smaller fragments, but it doesn't have time to break the big stuff down into the little stuff in the time Asian debris gets there, whereas our stuff, it's not as if we don't pollute. We've got 2.3 billion pieces of plastic flowing down the LA and San Diego rivers in just three days of sampling on a state-sponsored project, but that debris is going to wash around Hawaii towards Viet Nam and the Philippines, up towards Japan and then come around back into our garbage patch. So, it's taking,

you know, close to five years to get around there and by that time our stuff is busted up into little bits.

So, we don't tend...if you were just looking at the large debris, you would say, "Well, it's all coming from Asia," but if you look at the small debris, you have to wonder, you know, just how much of it is coming from our coasts as well.

Jennifer Stock: So, basically, once a piece of plastic enters the ocean it has a life of its own. In fact, touring more of the ocean than many humans do and it starts big and eventually photo-degrades to smaller and smaller bits. It never really goes away.

Charles Moore: Yeah. I mean, you hear estimates, groups will have boards at coastal cleanup days that will say how long a six pack ring will take to decay versus a cigarette lighter versus a Styrofoam cup, et cetera, et cetera, and some of the estimates are up to 500 years for some of those objects, but these are just guesses. I mean, we've only had consumer plastics for about half a century and if we're telling people it takes 5 centuries to degrade, that's just based on guesses looking at how the stuff photo-degrades and then eventually biodegrades. You see, the individually plastic polymer is several hundred molecules, maybe up to several thousand individual molecules long. This polymerization process makes a huge individual molecule.

So, you've got a situation in which there's no bio-engineered bacteria or nothing that can really eat petroleum-based plastics. So, even the individual plastic polymer itself must degrade further. So, you get down to, you know, extremely small microscopic sizes of plastic polymers that are floating around out there that still have to undergo further photo-degradation and break that polymer chain and it's unknown, you know, in many of these plastics how long that takes before some organism can come along and do what happens so quickly in a compost pile, turn things, you know, back into minerals and carbon dioxide and water.

Jennifer Stock: So, this must be raising many, many concerns amongst the biological community in regards to the health implications for marine life in the ocean. Many organisms filter-feed on plankton and maybe some organisms are thinking they're eating plankton and yet, they're eating plastic.

Charles Moore: Yeah, well, even non-thinking organisms probably are eating more than anything else. I mean, the base of the marine food web is not selective-feeding by things with eyes and taste buds. The base of

the marine food web is mucus-web-feeding jellies and salps, zooplankton, and krill that really, I mean, there's some selectivity in the larger zooplankton, but the smaller mucus-web-feeding jellies are basically eating anything they bump into.

They're not discriminating. They're not looking for something. They're just designed to take advantage of the fact that historically, everything out there was edible. I mean, except in some cases except for volcanic pumice, which floats on the sea surface. There was nothing out there. I mean, we do not find, unless it's a big log from the Pacific northwest or a huge bamboo stock from Asia, we don't find even chips of wood out there. Most everything is biodegraded by the time it gets to the central Pacific gyre. So, the issue of feeding and removing these plastics indiscriminately is a serious issue because we found at the 1 millimeter size class, if we had, say, 1,000 particles in our net, half a millimeter size class, we'd have half as many. In a third of a millimeter we'd have half, again, as many.

So, rather than, you know, having a cookie that crumbles into lots of tiny cookie crumbs, we were seeing, you know, these cookies, less crumbs than cookies. So, that means, tyo me, that these things are being removed from the system and I can't imagine that all of those are simply sinking because they're lighter than water and they mix thoroughly in the water column. So, a good possibility is that they're being removed by the base of the marine food web and it might not be so serious except for these things are sponges for oily pollutants. Anything that's, what we call lipophillic, you know, the tendency to absorb oily materials, any pesticide, herbicide, industrial chemical that has an oily character, these plastics are excellent...polymers are excellent at absorbing those.

So, we found absorption factors up to a million times the ambient levels in seawater. So, that you have, say, a PCB content in the seawater of one, you could have a PCB content in these plastic bits of a million and that's disturbing. That means that all these little bits being removed are being removed by organisms that are then subject to a pollutant load a million times greater than what they would be subjected to in the water itself.

Jennifer Stock: And then on itself up the food web too, I assume.

Charles Moore: Yeah, the bioaccumulation occurs, now we do have a question that we need to answer and that is, given the fact that these plastics are fairly open molecular structures and that these pollutants may penetrate fairly deeply into the polymer matrix, how much is

desorbed from those plastics into the marine food web during the digestion process, you know? We don't have answers to that question. That's the direction our research is taking us to find out the bioavailability and we have no doubts that the plastics are polluted.

Dr. Takada at the University of Tokyo has an international pellet watch going on looking for the pre-production plastic pellets that are 10 percent of the plastics that we find worldwide that disperse widely and they escape from factories, the raw material from the plastic industry 22,000 a pound and 300 billion pounds made each year and so a lot of them escape and he's soliciting pellets from citizens worldwide that'd be picked up off of beaches and sent to his lab and using them as a proxy for the water quality because he's the one that discovered these absorption factors of 10 to the 6th and, you know, we're getting a catalog of marine plastic pollution and what kind of levels of pollutants and what types of pollutants it contains through his efforts. So, yeah, I mean, there's no question that these things are polluted now. The question that we need to answer is when a jellyfish grabs a hold of one of these things and then is eaten by a sea turtle, how much of that pollution is being absorbed into the reproductive system of the sea turtle?

You might think a very small amount and that's probably the case, but it just so happens that these chemicals operate at levels astoundingly low. I mean, it can be a part per trillion and effect the reproductive system of these organisms. So, the amount desorbed needs to be studied. The effects on the animals needs to be studied and human studies are in progress and the results are in on some of them and the results are not good. I mean, if we are eating fish that have desorbed enough of these chemicals to be in the food that we eat, we're looking at reproductive failure in the matter of a few generations for large parts of our own species. It's a very serious issue and I think there's no longer any doubt that we've got to be very careful about bioaccumulation in the marine food web, pregnant women eating canned tuna, you know, it's just just the...

Jennifer Stock: It's not just the marine food web. It's the human health concern as well, which is very tied into why we need to care about the ocean as a whole because of the human connection. I just want to let listeners know they're listening to KWMR in Point Reyes Station. This program is Ocean Currents and we're talking with Captain Charles Moore. Charlie, I want to go back to your pellet watch, the website that Dr. Takada has because this is something people out here on the west coast or anywhere that might be listening that might go to the beach could potentially participate in. We've

noticed that in Point Reyes, I've started to see pellets appear as well in the drift line and they're pretty yellow by the time I see them and I know that on the pellet watch website, maybe you can give it because I don't have it here, Dr. Takada gives specific instructions, how to collect a pellet that you can then send in and he'll analyze and send back the results to whoever sent it in and that's something anybody can do. Do you know the website?

Charles Moore Yeah, it's kind of a funny website name. So, I just Google International Pellet Watch and it comes right up the first thing.

Jennifer Stock: Okay.

Charles Moore: And the yellow pellets he's found are more polluted the the clear ones. So, he's asking, you know, if you have a lot of them, he'd really, you know, like more of the yellow ones, but he'll take whatever you can give him. He'd like to get 200. You know, I recently returned from a visit to the North Sea and found 406 meters of strand line and went then to Sicily for a conference and found 223 in just two square meters of beach.

So, when you find, you know, other types of debris or seaweed washed up you may find a lot of these things. Then again, you may not find that many, but he analyzes them one at a time. The reason he wants a lot of them is to throw out, you know, outliers, and get an average, but no matter what you find you can find instructions on how to send it to him. I'm sure it will be gratefully received and this allows us to kind of have a proxy for the quality of the seawater where it was a very inexpensive way to expand our volunteer monitoring efforts worldwide and get, actually, fairly decent data on water quality offshore of the beach where these pellets are sampled because what he's done is taken mussels and grown them offshore where he's picked up his pellets and gotten relationships between the pollutants in the water and the pollutants in the pellets and he's got a fairly tight relationship to what these mussels are filtering out and what the pellets are filtering out and he can give you a pretty good idea of what the water quality is where you are by looking at your pellet.

Jennifer Stock: Charlie, here is an interesting idea that I just had. Is there, since there are so many toxic pollutants out there, microscopic, and as you said, like to attach to plastic, has anyone thought of some type of way to, this might be bad, but putting in huge amounts of plastic in a controlled setting where they're not drifting around, but they're maybe on a buoy where they could attract those chemicals or

pollutants and then a way to remove them from the ocean, is that too...

Charles Moore: Well, um...

Jennifer Stock: ...crazy to think about?

Charles Moore: ...let me just run you through the whole gamut of things and then you'll see the realistic or nonrealistic reality of your idea. First of all, in the event of an oil spill, the first thing that's deployed is booms and you know if you've done any looking around marinas and so on, you've seen these booms deployed around boats being fueled or in harbors you'll see big ships that are in port having these booms around them. Those are expanded polypropylene. Those are very rapid sponges for oily pollutants. Any oil or gasoline that's spilled in the ocean can be absorbed by plastic very quickly.

If you look on the web, you'll find all kind of companies advertising how fast their plastic booms and other media can absorb oily pollutants. In seconds, these things suck up just like a sponge in water, sucks up water immediately, these plastics suck up oil immediately. They're very effective in sucking up oil. I know the California Coastal Commission's Clean Boating Program provides bilge caps for recreational boaters, which if you throw one of these expanded polypropylene pads down in the bilge of your boat they will soak up the oil and then you can pump the water that's in your bilge overboard without polluting the ocean. So....

Jennifer Stock: So, it would basically be too quick. It absorbs too quickly. It wouldn't be a very efficient cleanup.

Charles Moore: Well, no. It's great that it absorbs quickly. That you want. Then you remove it and hopefully recycle it and, you know, you've eliminated some of the pollution in the ocean. Also, you know, on a little more somber note the, you know, nuclear industry wants to continue creating nuclear power after uranium supplies on land run out by putting, absorbing buoys, like you suggested, in the ocean to collect uranium out of the ocean and work is being done in Japan on that to collect metals, even radioactive metals out of the ocean.

So, there's many different media that can absorb things out of the ocean for different purposes. Now, your bottom line question, though, is, "Can we be effective in cleaning up the ocean with these technologies?" And the answer is, "No."

The ocean is the largest (unintelligible) pad on Earth. The average depth of the ocean is two miles. You cannot create any kind of cleanup for 1.37 billion cubic kilometers. Imagine a swimming pool. How many swimming pools would be in a cubic kilometer? Millions. You know, I mean, thousands, depending on the size of the swimming pool, but that's one cubic kilometer. A cubic kilometer is an enormous amount of water. There's 1.37 billion cubic kilometers of ocean and our research indicates it's fairly well-polluted.

I mean, we did research at 10 meters. We did research at 30 meters hauling these bongo nets that are designed to discreetly sample different depths and the amount of plastic at 10 meters was exactly equal to the amount of plastic at 30 meters. This stuff is totally mixed in and every single trawl had plastic in it. So, it looks like the stuff is just about everywhere and you can't examine it to get it out. So, you can't clean up the plastic itself and deploying more plastic, first of all, it wouldn't...you know, it might remove some of the pollutants in the ocean, but it wouldn't remove the plastic in the ocean and the plastic in the ocean is already polluted.

Jennifer Stock: Microscopic pieces of it still leaching.

Charles Moore: Yeah.

Jennifer Stock: Yeah. Well, so, we've got this huge issue of too much in the ocean and more coming and has there been any work in, maybe you're doing this, in working with the industry itself in finding out ways to reduce the amount of plastic we produce, finding alternatives? What type of work are you doing on the industry level?

Charles Moore: Well, you know, the plastic industry is responsible for about 10 percent of the problem. They like to say that if people just were more aware and disposed of their trash properly and took personal responsibility for their discards, we wouldn't have this problem, but as a matter of fact, based on our research, out of that 2.3 billion particles going down the L.A. and San Gabriel River, there was 236 million plastic pellets coming directly from industry. So, they're about 10 percent of the problem and if you look on beaches worldwide and count the fragments and count up the pellets, you'd get about 10 percent no matter where you are, whether it's in Pagan Island in the Marianas, or in Kamilo Beach in Hawaii...

Jennifer Stock: And you're talking just about the industry that the pellets are produced out of, not the...

Charles Moore: Yeah...

Jennifer Stock: ...actual plastic bottles.

Charles Moore: ...they're the plastics that are melted to make your plastic chairs and your plastic pipe and your plastic Venetian blinds and your plastic bags. Those are all coming to the factory that makes those things in the form of these little, less than 5 millimeter, plastic pellets, these little oval things that look like fish eggs and absorb up a million times the level of pollutants in the ambient seawater. So, you've got a situation in which the industry is releasing billions of poison pills into the ocean.

Now, we've worked with them on a plan called Operation Clean Sweep, which is designed to give personal responsibility, if you will, to the individual plastic factory to, you know, do basic housekeeping, not let these things get on to the ground and flow out with the storm water, but it's a voluntary program and it costs money for the companies to sign up with the APC and the SPI, the American Plastic Council and the Society of the Plastic Industry, and get the instructions on how to do this program and get listed on their website as a participant and I think there's probably less than one percent of the total plastic processors signed up for this, but having said that and 10 percent of the problem is their pellets, the industry itself is responding to marketers and to Wal-Marts and other supermarket chains that are demanding this fancy packaging.

I mean, if you go to buy a tiny little chip for your camera to put your digital photos on, you get it in a package that's hundreds of times the volume and hundreds of times the weight of the actual chip that you're buying. That's not because the plastic industry told the marketers to do that, that's because the marketers requested the plastic industry to make that stuff. So, what we've got to do if we want to change the quantity of plastics produced and discarded as waste is to work with the people designing products to design for recycling. We've got to get into the heads of the advertisers and (audio interruption).

The idea that this trajectory of more and more packaging, you know, and it's reflected almost one to one in the ocean, there's almost 30 percent plastic packaging of all thermoplastic production and out in the ocean we found 27 percent thin plastic films in the middle of the ocean. So, these plastic packaging, just about in the same percentage they're made on land are winding up in the ocean and, you know, only about 3.5 percent of plastics is recycled in any

way. A lot of these plastics you're carefully sorting in your bin are just going to be incinerated or landfilled.

Just about the only thing that's really getting anything done with is the bottle bill because it's subsidized beyond the value of the bottle itself so that industry can be kick-started into taking some of this stuff back.

Jennifer Stock: Charlie, we were just talking about recycling and this has been a big concern of mine because many of us think, "Oh, I can buy that because it's recyclable and it has the little arrow on it and it's ok!"`

Charles Moore: Yeah, no. The chasing arrows is extremely misleading. It only designates the type of plastic, not whether it's recyclable or whether it has any recycled content. This was fought for by the industry as a kind of manufactured uncertainty, which I'll talk to you more about later, but it creates the image in the public's mind that this is a user-friendly product, but as a matter of fact, many of these products are extremely dangerous. For instance, the polycarbonate bottle leeches bisphenol A and they're used in baby bottles and the babies are extremely sensitive to bisphenol A in very low doses and I can get into that later, but right now we're talking about recycling and I think to make recycling work, what we need is an infrastructure that's based on a suite of plastics that are easily recyclable and the only way to get that done is to have the recycling infrastructure kickstarted by government.

The industry will only come up to the plate when they have subsidies and that's shown by the bottle bills. Bottle bills work in the sense of getting back about 60 percent of the bottles, but you have to pay more for the bottle than the plastic material itself is worth. Now, eventually if we want to make recycling sustainable, we've got to have products that the value of the recycled material is sufficient to fuel the industry that recycles it so that...we've got to design products out of plastics that are easy to recycle and that can then be made into products that complete the closed loop.

As it is now, virtually all plastic recycling is down-cycling. None of the trillions of milk bottles has ever been made into another milk bottle simply because, as I talked about before, plastics are lipophilic. The milk that gets in there, the melting temperature of plastics is not high enough to drive off the oily milk fat that's in the plastic matrix. So, any milk bottle that's made into another milk bottle, to have food contact be legal for that bottle it would have to be coated with a layer of virgin plastic on the inside. So, there's no closed loop. What you get is, you know, carpet, you get fleece, you

get fabric, you get plastic wood, and eventually all that stuff winds up in the landfill.

Now there is efforts being made by Patagonia to put in their stores a bin where you can bring your old Patagonia fleece in...

Jennifer Stock: And your underwear, I understand.

Charles Moore: ...and what they've done is they worked with a Japanese company to invent a machine that will sort that stuff and take the zippers off and make it into a fabric that can be reused in a garment and they think that's adding value to their product and the wave of the future and I have to agree with them. I think that what we need to have is this concept William McDonough pushes in Cradle to Cradle of technical nutrients that we get it with biologicals. We know we can take a tomato and compost it and fertilize and make another tomato, but there's an infinite cycle that can go on forever without harming the environment.

There is such a concept that could be applied to industry in which...

Jennifer Stock: I think it's great. Yeah.

Charles Moore: ...yeah, we have a technical nutrient that can feed an industry that then makes this product over and over again, but that will require, as you say, kind of a regime change in the way we think right now and it's going to require fewer and less creative product design in a certain sense. Less composite....you know, it's very difficult to think that one of these potato chip bags that has the aluminum coating on the inside and the plastic on the outside, they do that to make a better vapor (audio dropout) because metal is more resistant to air transport, but that makes it tougher to recycle. You've got to separate the aluminum from the plastic and, you know, there's ways around that stuff.

So, yeah, it's not going to be easy, creating a recycling infrastructure in which the plastics have a sufficient value so that, say, when your recycle bin gets picked up, you get that value of the things that you put in the recycle bin deducted from your trash bill. I mean, I think you should be paid for your recycling and it should come off the cost of picking up your trash because you're contributing value to industry by recycling. Now, you know, we're a ways away from that, but I think that's the direction we have to go.

Jennifer Stock: Well, I think it's great there are some companies that are field testing some of these technologies and that maybe will stimulate other companies to do the same, but in reality, it sounds like consumers really need to just reduce and reuse as much as possible, the other two R's that are pretty significant in just reducing our use of plastics.

Charles Moore: Yeah. They don't get the billing that the recycling does and the recycling really is kind of a smokescreen for a really non-sustainable throwaway society that basically wastes 95 percent of the stuff, plastic resources.

Jennifer Stock: Yeah. The way I think about it a lot of times is, like, if you buy a plastic container of orange juice at the store, you'll drink that in about two minute, but then you have a lifetime of plastic left over from that drink and I try to think of that sometimes when I'm at the store making choices of things to buy.

Charles Moore: Yeah, well, another thing you need to think about when you're making choices of things to buy with plastic is the leeching of the plasticizers. You know, virtually all plastics have phthalates in them, polybrominated dyphenol ethers and your polycarbonates got bisphenol A. Now, those are all hormone disruptors and they (audio dropout) obesity and diabetes epidemic is probably related to the exponential increase in these man-made chemicals over the last two decades.

We're getting heavy doses and every woman in America has a heavy dose, American women have the heaviest dose, of PVDE's. There's no women free of these chemicals and these things have averse effects on sperm count, the ovary, and changes in behavior following pre-natal exposure. I mean, these compounds have the potential to impact development in every system in the body. You know, the developing organism, the embryo, the fetus, the neonate, and the pubertal individual that are particularly sensitive to endocrine disruption and you know, even though these chemicals provide us with many advantages, we need to be more discerning regarding their applications to consumer products in order to lower the risk for this particular sensitive population of women and children.

Jennifer Stock: So, this is applying to humans and I'm assuming this also applies to the marine wildlife in the ocean that is effected by this up the food chain and...

Charles Moore: Oh, yeah. We have snails, marine and aquatic snails, now are producing what we call super females. They have additional female organs, enlarged accessory sex glands, gross malformations of the palial oviduct, and a stimulation of egg and clutch production resulting in increased female mortality. There was 15 percent mortality in exposed snails versus a control mortality of 4 percent.

So, there are significantly statistical effects that these concentrations that are, you know, similar to what humans are getting. So, the animal data is coming in. I mean, we're seeing mice that become obese when they're exposed to these chemicals. We're seeing mice behavior, I mean, the male mouse, the male rat, the lab rat, spends virtually no time on the nest with the babies. The female that gives birth and nurses the babies, but if you expose a male rat to some of these plasticizers, it spends more time on the nest than the mother does, I mean, and humans we're seeing undescended testicles. We're seeing the fat pad of males start to resemble the fat pad of women. It's just an amazing series of experiments and lab results that are just skewing out at an exponential rate.

I mean, plastic in the ocean has increased exponentially in the last decade. It was going up about the level of production and then with the globalization and everything being packaged in plastic, it went up exponentially. It goes up by a factor of 10 every 2 to 3 years off of Japan. It went up by a factor of 100 in the southern ocean in the 1990's. Well, the effects of these chemicals are also going up exponentially and the research, fortunately, is starting to go up exponentially as well and so it's no longer a question of, "Are they affecting us?" It's a question of, "How bad," and "Which population is most affected," and that's what these results are showing.

That the really serious things are in the developing fetus and the child and the mother. Although, male sperm counts are down 50 percent as well.

Jennifer Stock: I think this is a good example of where scientists are really going to have to work to communicate findings with the media and the public because it hasn't really been in the media all that much until recently. I'm just starting to see articles on these topics and I think when the science has got some conclusions to share, I really hope that scientists will help share this information to get it out.

Charles Moore: Well, the World Laborartory just sponsored a world symposium on plastic pollutants in water at the 36th International Conference on Planetary Emergencies and the scientists of the world assembled there elevated this topic to a level of nuclear proliferation, global warming, and avian flu. I mean, the level of seriousness of the plastic pollution and the chemicals in plastics affecting our world is now on that level. So, you're right. More publicity definitely needs to be devoted to this topic.

Jennifer Stock: Well, that's a great segue way because there are some local artists here in West Marin, Judith Selby Lang and Richard Lang, who have been working to share their inspiration, mainly a large part from your work, Charlie, to let people know about the drastic changes in the environment and Richard Lang, I believe has joined us. Richard, you're on the air.

Richard Lang: Hello. Can you hear me alright?

Jennifer Stock: Yes, welcome

Charles Moore: Hi, Richard!

Richard Lang: Hey, Charlie!

Jennifer Stock: So, I'm...it's really great to have all of you here because you've both been inspirational to me as an educator and I'm glad to have you both on and Richard, I'm hoping you can share with us a little bit about this upcoming installation you have at the University of San Francisco.

Richard Lang: Oh, it's up right now. It's at the Geschke Library in the fountain part of an exhibit called "Earthly Concerns" and outside the library there's a fountain and we had floated 4,600 pieces of plastic, which according to Charlie's figures, 4,600 is approximately the number found in every square city block in the ocean. So, there's a lot of plastic there. It's wonderful to watch people walk by.

We set it up a week ago and everyone stops and, "What's this?" So, we tell them.

Jennifer Stock: Is there some written piece of the exhibit there so...

Richard Lang: Yeah. All along the edge of the fountain there are four or five little explanations.

Jennifer Stock: That's excellent. So, how long is this going to be up. Is this something that anybody could go and watch?

Richard Lang: Anyone can go. The exhibit is from August 21st and it's up 'til October 22nd. On Thursday, September 7th, Judith will be on the artists' panel in the Maraschi room in Fromm hall in USF.

Jennifer Stock: Is there something on the web you could send people to to find more information?

Richard Lang: I'm sure there is if you go to the USF website

Jennifer Stock: USF website and both of you have been doing projects like this for a while, bringing attention to the drastic change in the amount of plastic in the ocean. Can you describe some of the other projects you've been doing?

Richard Lang: Well, it's been 8 or 9 year, but lucky us, we have a bard where we can store the 3 and a half tons of the stuff we've picked up and so we've been making art exhibits. We've had over 20 exhibits of the things. We had a show at the Bay Model, which is for the Army Corps of Engineers in Sausalito and we did a kind of a fantasy show. It was called "The Plasticine Discontinuity" and it was a fantasy of 12,000 years in the future where a geologist and an anthropologist have discovered this anomalous layer of rock that's not rock at all, but plastic and so the exhibit was what they'd mined out of this layer of this geological layer.

Jennifer Stock: That's excellent.

Richard Lang: It was funny.

Charles Moore: You might like to know that seven times the amount of plastic that's in your bard flows from LA down the two major rivers every day.

Richard Lang: So amazing, isn't it?

Jennifer Stock: That's every day through two rivers. That's not even considering the rest of the world.

Richard Lang: That's right.

Charles Moore: Just the LA Basin.

Richard Lang: You should also know that we're in no way cleaning up the beach. We call it curating the beach. We're just picking up the good stuff.

Jennifer Stock: I think that's great, Richard.

Richard Lang: We've got a great collection of plastic pellets and nurdles and we're having a show at the San Francisco Museum's Artist Gallery in Fort Mason in November and we've got, at my print shop, Trillium Press, we've photographed and printed really large, you know, 4 by 5 foot images of these little plastic pellets and the whole idea is, you know, we all get numbed to these facts and they no longer circulate in our minds, but when you see this artwork and you see it with a little bit of good humor, you see it with just pure beauty, somehow the message gets across a little bit better.

Jennifer Stock: That's great. I know you have some competitors out here on the beaches now that they've realized what they can do with this stuff, that it's not viewed so much as trash, but it can be viewed as an art resource for free.

Richard Lang: That's right.

Charles Moore: But, you know, you need to realize that the beach cleanups have no effect on the amount of trash deposited on the beach.

Richard Lang: No.

Charles Moore: It depends solely on the amount of rain.

Richard Lang: No. Absolutely. Yeah, we get, you know, our high season is in February when we get a lot of rain. No, we're not cleaning up the beach in any way. We're just trying to draw attention to it. We've got a little 1980 Chevy LUV pickup that's completely covered in white plastic and it's all from Kehoe Beach in Point Reyes Seashore.

Jennifer Stock: Yeah, Charlie, we took this idea as well this year and we had a giant pacific octopus float go down main street for a parade out here and it was covered in marine debris and most of it was plastic caps from water bottles, soda bottle...

Charles Moore: That's a really, really big problem for birds. The Laysan albatross loves bottle caps and, you know, they're a different kind of plastic. They're not covered by the bottle bill. You're not getting any bottle caps recycled by recycling your plastic bottles under the bottle bill. They're polypropylene. The bottles are polyethylene. Only the

polyethylene is recycling. Right now there is no polypropylene recycling industry. Every single bottle cap is waste and birds are eating tons of those things. 200,000 Laysan albatross chicks die every year full of bottle caps on Midway and Kure Atoll in the Hawaiian chain. We've got to have a program to deal with bottle caps and one of the things we're doing, we're helping to sponsor a paddle from the Oregon border to the Mexican border by Tom Jones, an extreme athlete, who is going to talk to people about the bottle cap issue.

We'd really like to see a company like Patagonia step up to the plate and take back the bottle cap because they are killing wildlife by the millions.

Jennifer Stock: When does this paddle start?

Charles Moore: It's starting at the end of the year, I think he's doing (audio drop out) waterways first. He's going to be coming up to your area and saddling Lake Merritt and doing some inland waterways because we don't really have any data for what's in the lakes, you know? We've got some stuff on the rivers. He's going to try to do Sacramento River too, but he's gonna do the run up to the extreme paddle by doing the inland waterways and I think next year he'll do the extreme paddle, I think during the good weather part of 2007.

Jennifer Stock: So, what I'd like to...we're getting close towards the end of the show and I would like to ask both of you, what is the one thing you would like to tell people about their role in protecting the ocean. I'd love for both of you to answer.

Richard Lang: Charlie?

Charles Moore: The one thing I would talk to people about in terms of taking their role in the oceans is, you know, to think very long and hard about future generations and plastics effect on them. The only way I think people are going to be motivated to reduce their consumption of plastic is if they realize that it's lowering the sperm count in men, it's making fertility clinics go sky high in profitability, and you have to realize that most of these artificial insemination things yields twins and twins are much more susceptible to birth defects and it's a big issue having all of our insemination done artificially.

So, when you're thinking about plastic in the ocean, think about yourself. Think about your future. Think about your family. Think about these chemicals leeching out of this plastic. All of these plastics have things that are leeching into the stuff that you're

eating and it's now proven that these endocrine disruptors are affecting you and your family and the evidence of obesity, diabetes, attention deficit disorder. So, I think the way to get you to reduce your consumption of plastics that eventually makes its way to the ocean is to just have a little enlightened self-interest. Take care of yourself. Steer clear of that stuff.

Richard Lang: You know, it's true. I think writing to...individuals writing to the manufacturers of the products they buy is really important. It really gets people's attention and, you know, for example write to the local newspapers. Every day in San Francisco, newspaper is delivered in plastic bags. In San Francisco alone there are 18 million plastic bags that are just completely unnecessary in dry weather.

Write to the IJ, write to the Chronicle, whoever's delivering your newspaper. I mean, things as simple as that. It's important to actually be involved. Those plastic bags when they are used can be made of recyclable materials. The city of San Francisco has a program for recycling organic wastes and they provide plastic bags that are biodegradable. This is a real possibility, but it's expensive at first and once the scales get tipped, people will be doing this as a real gesture.

Jennifer Stock: Excellent. I want to thank both of you for taking some time to share your experience and knowledge with the community of Point Reyes and live on the web, maybe worldwide, KWMR.org and I look forward to seeing this exhibit in San Francisco and, Charlie, I look forward to continuing to work with you on some of our education projects.

Richard Lang: Charlie, it's a real pleasure to talk to you. You're a real hero to me.

Charles Moore: Oh, I, you know, it takes a break with the status quo that only art can provide to get people's awareness. So, I also admire your work.

Richard Lang: Well, thanks.

Jennifer Stock: Excellent. Well, I'm going to sign you guys off for now, but we'll be in touch soon. Thanks for joining us again.

Richard Lang: Thank you, Jenny.

Charles Moore: Thanks, Jenny.

Jennifer Stock: You're welcome. Take care.

Charles Moore: Buh-bye.

Richard Lang: Bye-bye.

Jennifer Stock: So, folks we've been listening to Captain Charles Moore and Richard Lang, a local artist, talking about plastic and the ocean and we have a lot to do in the future and a lot of this has to do with future generations and teaching our youth and our current populations to reduce and reuse as much as possible.